ELE 055

Electricity

A form of energy resulting from the movement of charged particles, such as electrons or ions.

Basic Electrical Quantities

Voltage (V) – Voltage is the difference in electric potential between two points in a circuit, which causes the flow of current. It is measured in **volts (v)**.

Current (I) – The flow of electrons through a conductor. Current is measured in **Amperes (A)**

Resistance (R) – The opposition to the flow of electric current.It depends on the material, temperature, and size of the conductor. Unit is **Ohms (Ω)**.

Electric Power- Rate at which electrical energy is consumed or produced. Measured in **Watts (W)**

Unit Conversions

- 1K (kilo) = 1000
- 1M (Mega) = 1000,000
- 1G (Giga)) = 1000,000,000
- 1m (milli)) = 0.001
- 1u (micro) = 0.000001
- 1HP (Horsepower) = 746 Watts

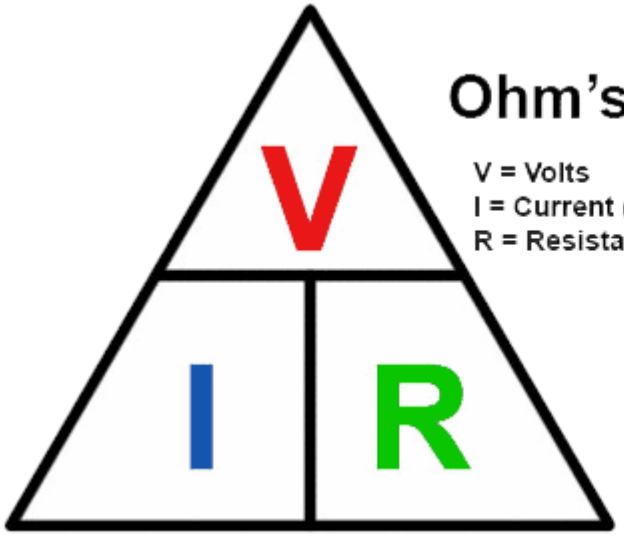
Conductors and Insulators

Conductors - materials that allow electric current to flow easily through them because they have free electrons

Insulators - materials that do not allow electric current to flow easily through them

Ohm's Law

$$V = I \times R$$



Ohm's Law

V = Volts
I = Current (in Amps)
R = Resistance (in Ohms)

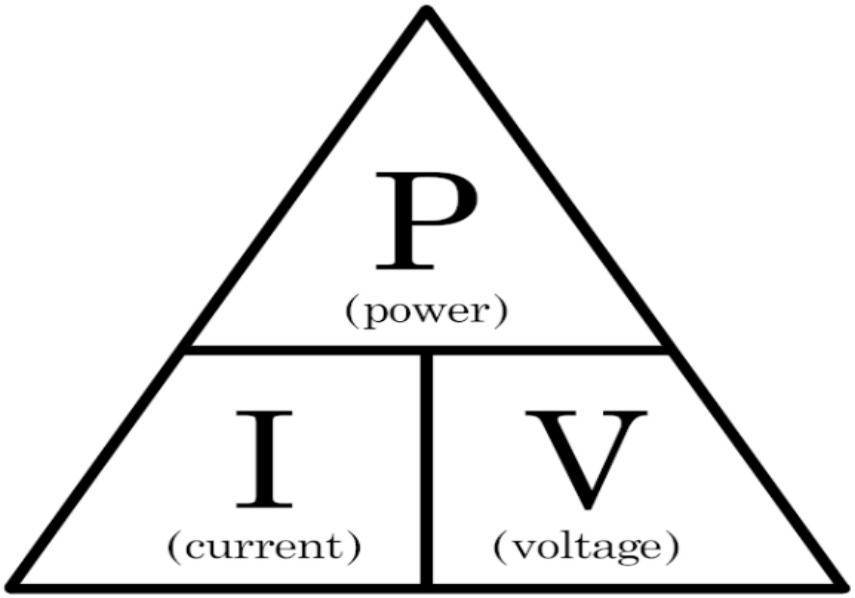
$V = I \cdot R$ (volts = amps times ohms)

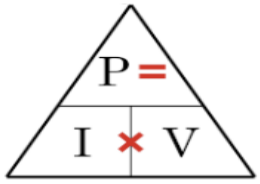
$I = \frac{V}{R}$ (amps = volts divided by ohms)

$R = \frac{V}{I}$ (ohms = volts divided by amps)

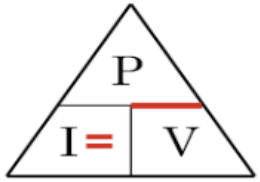
Electric Power

Power Formulas

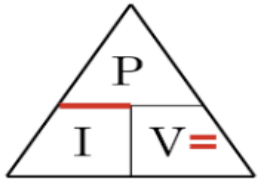




$$P = I \times V$$



$$I = P \div V$$



$$V = P \div I$$

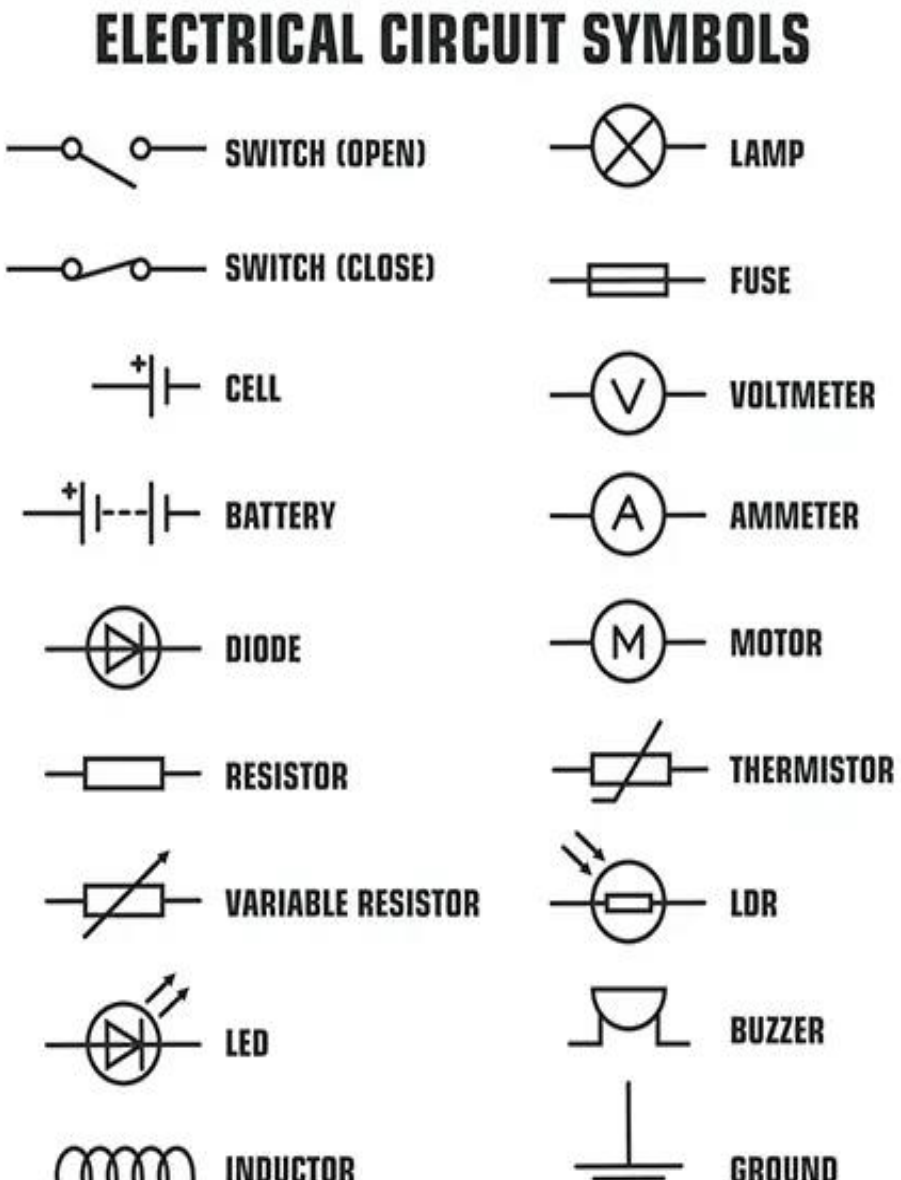
Electromagnetism

- Magnets have north and south poles.
- Electromagnet produces magnetic field when current flows through it.
- Moving charges produce magnetic fields and changing magnetic fields induce current.
- Faraday's Law – Changing magnetic fields induce current.

Electric Components

- Power Sources – Generators, Batteries
- Conductors – Cables, Busbars
- Loads – Motors, Heaters, Bulbs
- Control – Switches, Circuit Breakers
- Protection - Circuit Breaker, Fuses, Surge Protectors
- Passive Components – Resistors, Inductors, Capacitors

Electric Components



Electric Circuits

- Closed path that allows the flow of current.
- Series circuit – Component connected end-to-end, and current is the same.
- Parallel Circuit – Components connected across each other and voltage is the same.

Kirchoff's Laws

- KCL – Sum of Currents entering a node is equal to the sum of currents leaving it.
- KVL – Sum of all voltages around a closed loop is zero.

Measuring Devices

- Testers
- Analog and Digital Meters
- Multimeters – Voltage, Current, Resistance, Continuity
- Voltmeters, Ammeters, Wattmeter
- Insulation Resistance Meter - Megger

DC Voltage

- Constant unidirectional flow of current.
- The waveform is usually a straight line. Voltage is constant.
- Sources of DC voltages are batteries and solar panels.

AC Voltage

- The direction of current alternates periodically.
- Commonly in sinusoidal waveform.
- Generated by alternators.
- Frequency is 50Hz.
- The peak value is the maximum value of the voltage.
- Effective value is the RMS value.
- Single phase and three phase voltages.

Single Phase System

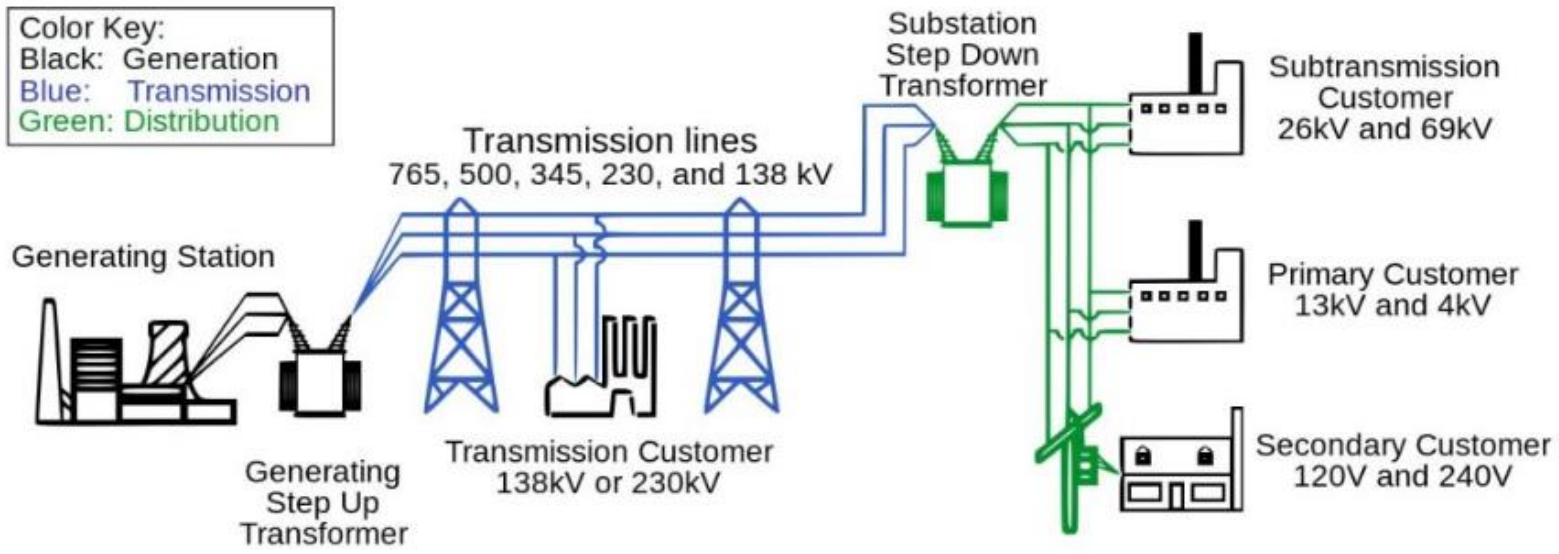
- Current flows through a single set of conductors.
- One conductor is Live/Phase and the other is Neutral.
- The voltage is 230V, 50Hz
- Power = Voltage * Current * PF

Three-phase System

- Uses three separate circuits/phases to transmit power.
- The phase difference is 120 degrees.
- Phase Voltage - Voltage between phase and neutral is 230V.
- Line Voltage - Voltage between any two phases is 400V.
- Line Voltage = 1.73 * Phase Voltage
- Three Phase Power = 1.73 * Voltage * Current * PF
- Connection Types – Star or Delta

Power System

- A network of electrical components for generating, transmitting and distributing electrical power.



Power System Components

- Generation: Synchronous generators in power stations produce electric power in three phases. They convert mechanical energy into electrical energy.
- Transmission: Large amounts of electrical power is transmitted from generators to distribution systems using transmission lines at high voltages.
- Distribution: Electric power is distributed to consumers through step-down transformers at low voltages.
- Control and Protection: Monitoring and control mechanisms to protect the system from faults.

Reasons for HV Transmission

- Decrease power losses.
- Decrease voltage drop.
- Decrease size of conductors.

Single Line Diagrams

- A simplified notation for representing an electrical power system using symbols for each electrical component.
- Transmission Lines: Electrical conductors which transmit high voltage electrical power from power plants to substations.
- Busbar: A conductor to collect and distribute electrical power.
- Feeder: A conductor used to distribute electrical energy from substation to different parts of the network.

Power System Protection

- A system which protects the electrical power network from abnormal conditions.
- Electrical faults – Short circuits
- Over and under voltages
- Overloads
- Loss of synchronization
- Reverse power

Reasons for Protection System

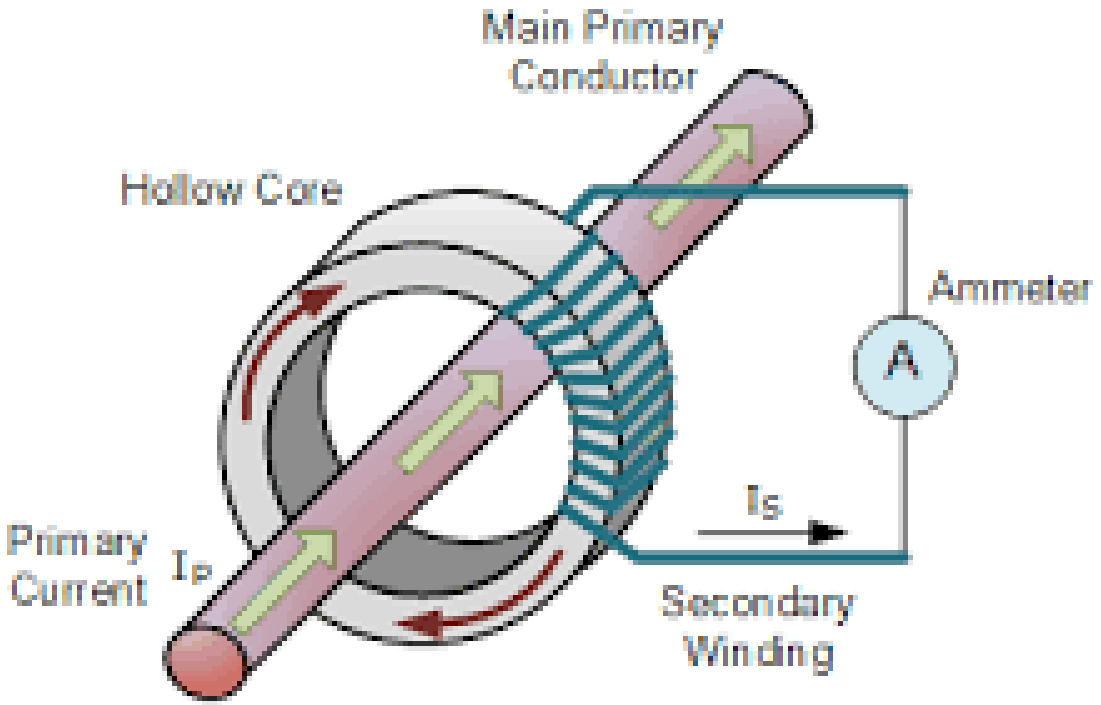
- Prevent electrical hazards.
- Protection of the equipment.
- Fast and precise fault isolation.
- Fast power restoration.
- Prevent failures which may cause collapse of the entire grid.
- Overload prevention.
- Minimizing cost.
- Reliability of power supply

Functions of Protection System

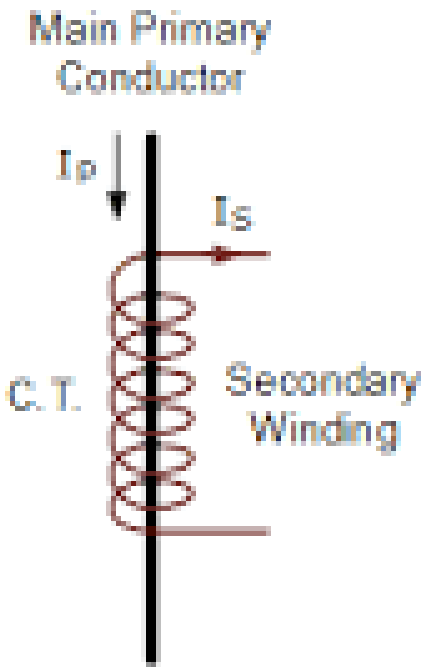
- Prevent or limit the damages during faults or overload conditions.
- Disconnect the part of the system under the fault. The healthy part of the system should run without any interruption.

Elements of the protection system

- Current Transformer
- Voltage Transformer
- Protective Relay
- Circuit Breaker
- Batteries.



Construction



Circuit
Symbol


Inter Win Current Transformer
150/5A , 350/5A , 600/5A
CURRENT TRANSFORMER
RATIO : 350/5A VA : 15 CLASS : 1
RATIO : 150/5A VA : 15 CLASS : 1
RATIO : 600/5A VA : 15 CLASS : 1
Inter Win
ES
ELECTRIC SHOP


SDR
CURRENT TRANSFORMER
STARDARD IS C1731
ACC CLASS 1.0
INSUL CLASS 0.6 KV
RATED BURDEN 30 VA

CT and VT

- Current Transformer: Reduces high currents to lower values of current suitable for monitoring, control and measurements.
- Voltage Transformer: Reduces high voltages to lower voltages.
- Connection of CTs and VTs.

Protective Relay

- Protective relay detects the fault and trips the circuit breaker.
- Inputs and outputs of the protective relays.
- CTs and VT inputs and relay settings.

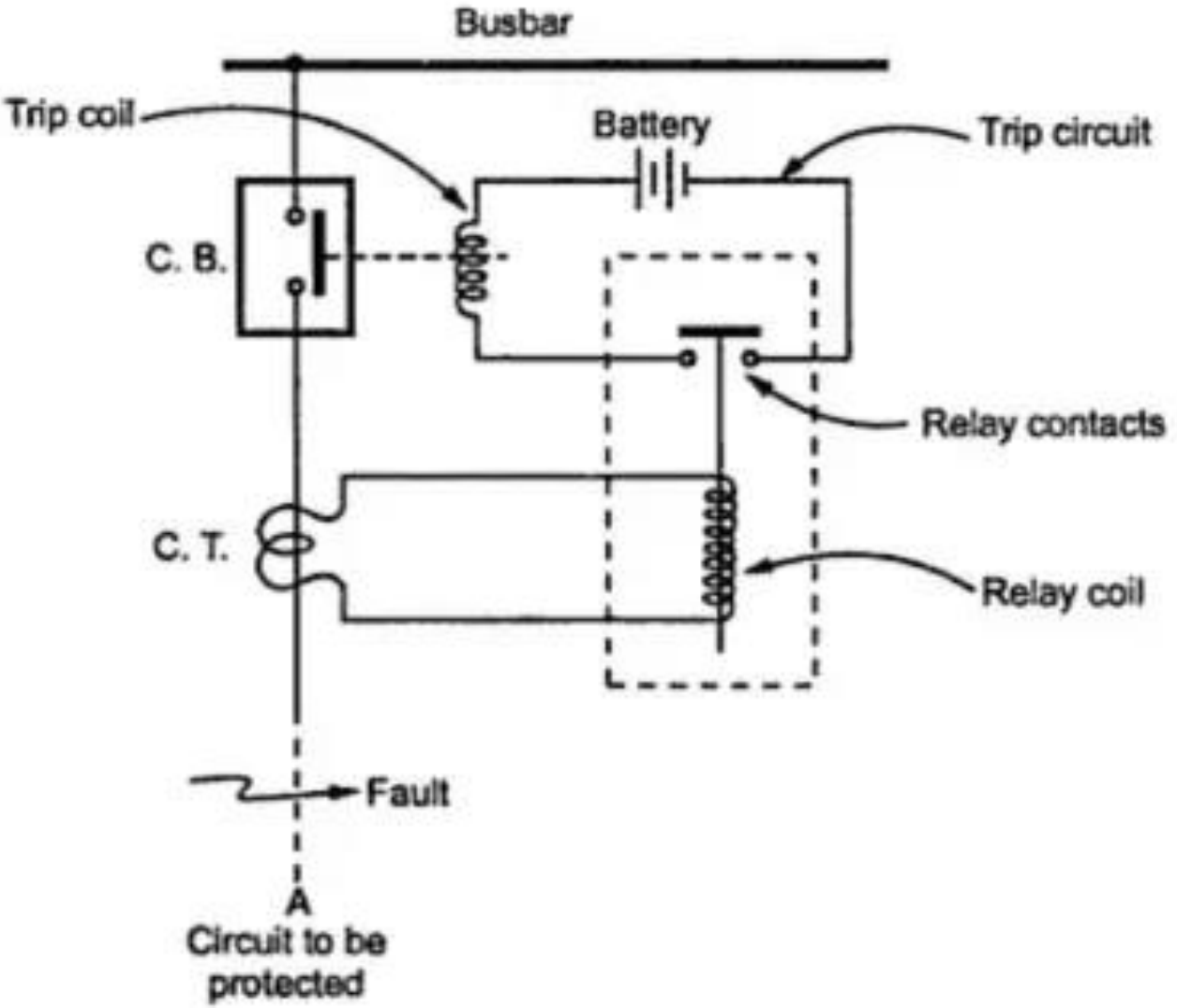
Circuit Breaker

- Automatic electrical switch designed to interrupt the circuit in case of faults.
- Status of CB during normal operation and under faulted conditions.

Basic Terms of Protection

- Pickup Value: Threshold value of the operating quantity, above which the relay operates and gives trip signal to the breaker to interrupt the circuit.
- Fault Clearing Time: Time between the occurrence of the fault and final arc extinction of the circuit breaker.
- Relay Time: Time between the occurrence of the fault and closure of the relay contacts.
- Breaker Time: Time between the closure of relay contacts and final arc extinction of the breaker.

Trip Circuit



Trip Circuit Operation

- When the current exceeds the threshold value the current in the relay coil increases.
- The relay contacts close the tripping circuit.
- Tripping coil opens the contacts of the circuit breaker which opens the circuit.

Fuses

- Fuse — An OCPD with a fusible link that operates and opens the circuit on an overcurrent condition.
- Works on thermal effects of current.
- Overload and short-circuit protection.
- A fuse element is made of zinc, copper, silver, aluminum, or alloys because they provide stable and predictable characteristics.
- Prevents fire and protects equipment.
- Rejection cases.

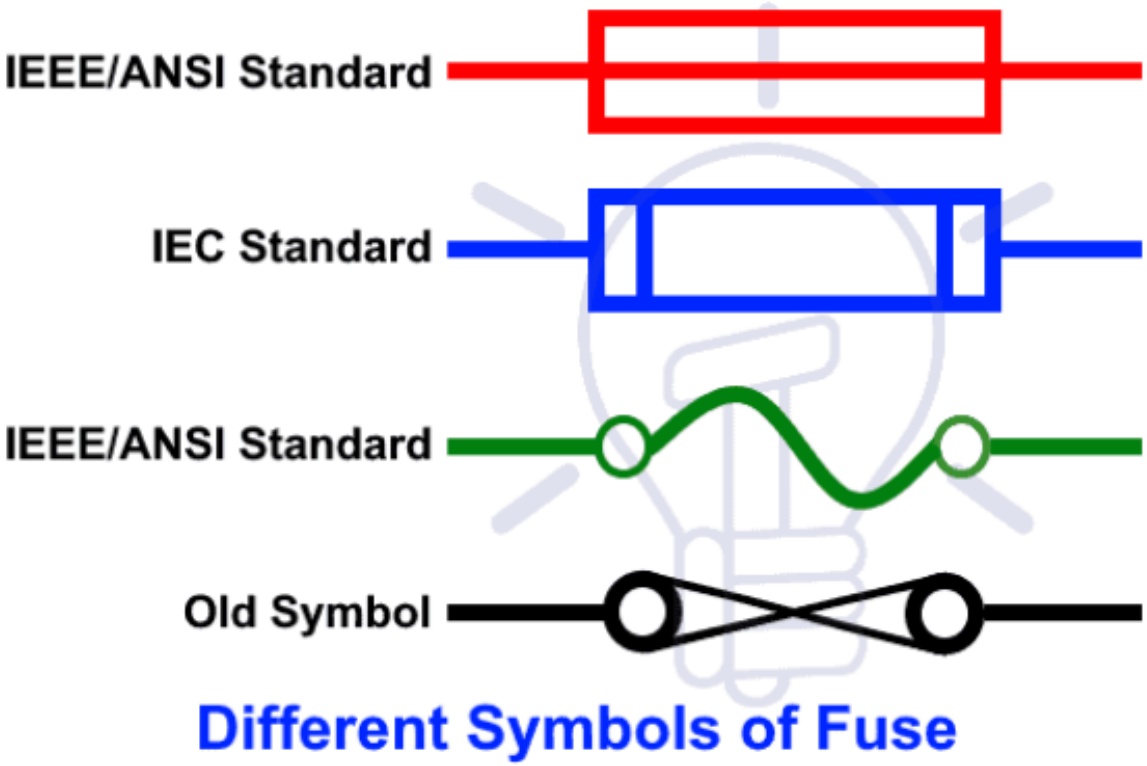
Fuses

- Current carrying capacity is the amount of current which a fuse can easily conduct without interrupting the circuit.

- Breaking Capacity is the value of maximum current that can be safely interrupted by the fuse and should be higher than the prospective short circuit current.

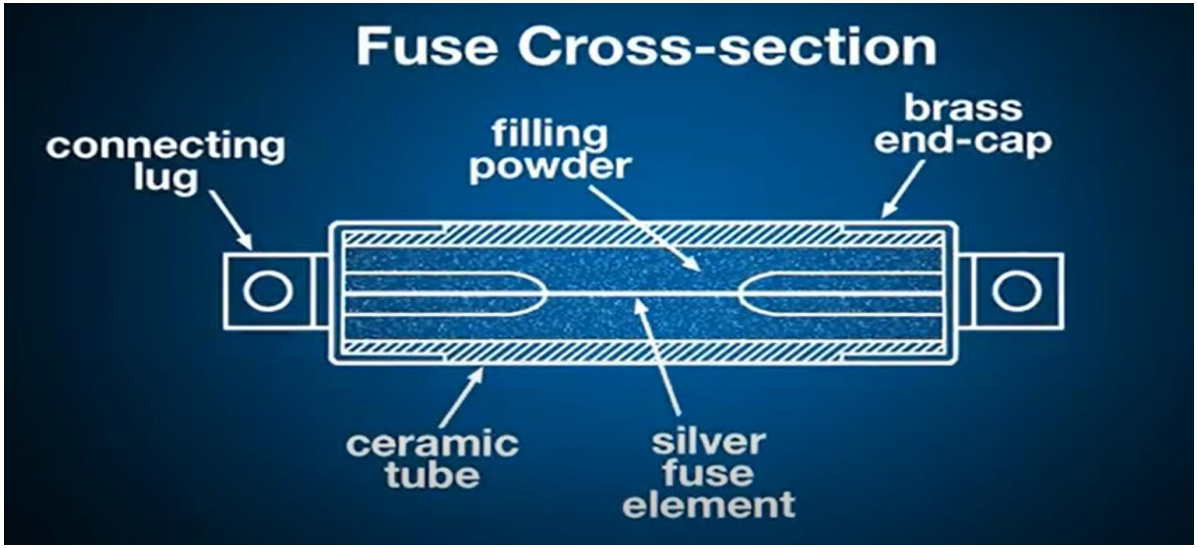
- **I^2t:** It is the amount of energy which is carried by the fuse element when the electrical fault is cleared by the fuse.

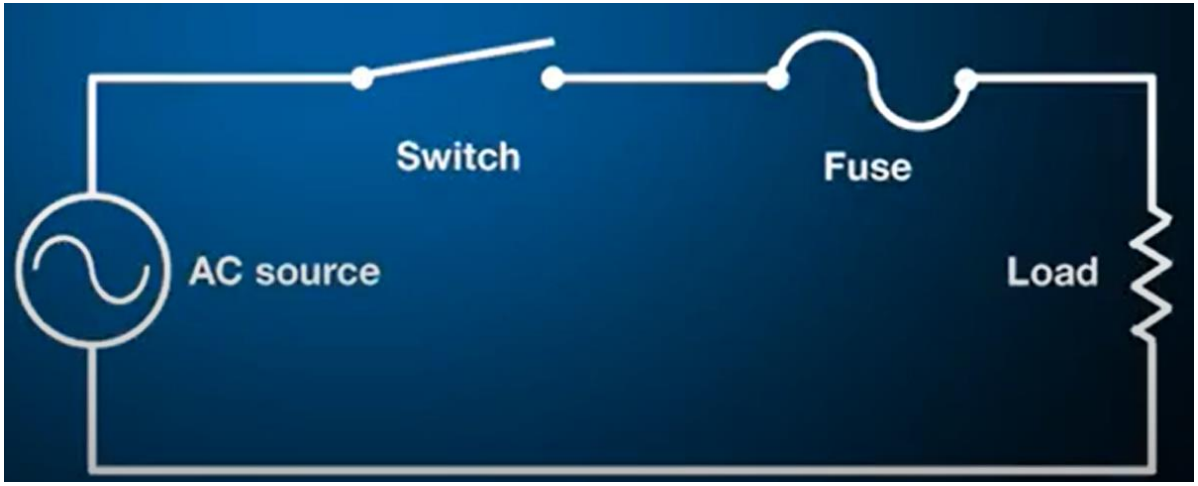
Fuse Symbol



Different Symbols of Fuse

Fuse


Fuse Cross-section
connecting lug
filling powder
brass end-cap
ceramic tube
silver fuse element


Switch
Fuse
AC source
Load

Function of fuses

- Protect from heat: Overloads
- Protect from magnetic forces: Short circuits
- Fast acting fuses
- Time delay fuses

Fusing Factor

- It is defined as the ratio of the minimum fusing current to rated current.
- Rated current is the current that the fuse can carry indefinitely without melting.
- Minimum Fusing Current: It is the minimum current (rms value) at which the fuse element will melt.
- This factor is always more than unity.

Choose the Right Fuse Size

- Fuse Rating = (Power ÷ Voltage) x 1.25
- Choose the value of the fuse greater than the calculated value

Properties of Fuses

- Current Rating
- Breaking Capacity
- Voltage
- Response
- Differences between AC and DC fuses

Types of Fuses

Rewirable Fuses

1. Cheap
2. Should use correct gauge of fuse wire.

Precision Fuses

1. Accurate values
2. Replace with the same value an same type

Types of Fuses

Current limiting fuse: Applies to short circuits, clears the fault less than ½ cycle**.**

Fast acting fuse: A fuse that opens on overload and short-circuits very quickly.

Time-delay fuse: A fuse with a built-in delay that allows temporary and harmless inrush currents to pass without opening.

Fuse Class

- Class CC: time delay, fast acting, 30A
- Class G: time delay, fast acting, 60A
- Class RK: current limiting, fast acting, 600A
- Class T: current limiting, fast acting, used in VFD
- Class J: current limiting, fast acting, 600A, small motor ckts
- Class L: current limiting, time delay, high currents.

HRC Fuses

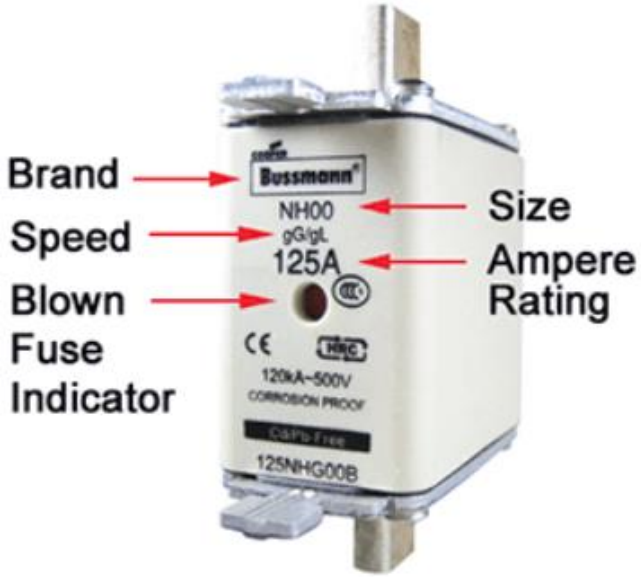
- High Rupturing Capacity Fuse
- Used in high voltage and high amperage applications
- Has a high breaking capacity
- Has a heat-resistant ceramic body
- Cavity is filled with silica sand and is airtight.
- Arc creation in high currents and arc quenching.
- Can be used for motor protection and in PV systems.

Fuses

- Inrush current: It is the maximal instantaneous input current drawn by an electrical device when first turned on.
- Short-circuit —exceeds the normal full load current of a circuit by a very high factor and does not flow in the normal current carrying path of the circuit.
- Overload: 1- 6 times load current.
- Fault current: Short circuit, ground fault, arcing fault.

Fuses

- Time-current characteristic curves (TCC) are graphical representations of the OCPD's operation under different overcurrent conditions as plotted by amps and time.
- Fuses have inverse time characteristics – thermal devices.



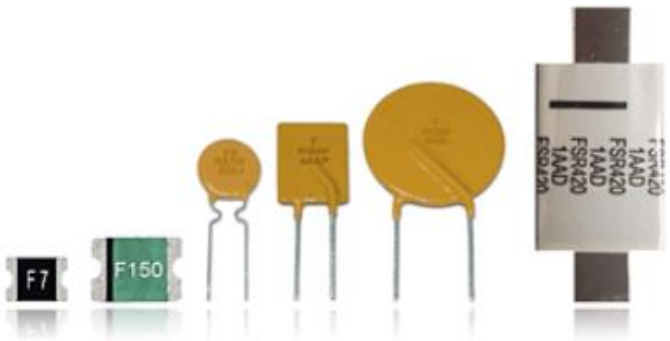
Industrial Fuses

PV Fuses

Semiconductor Fuses & Very Fast Acting Fuses (Ultra Rapid Fuses)

Car & Automotive Fuses

Miniature Fuses

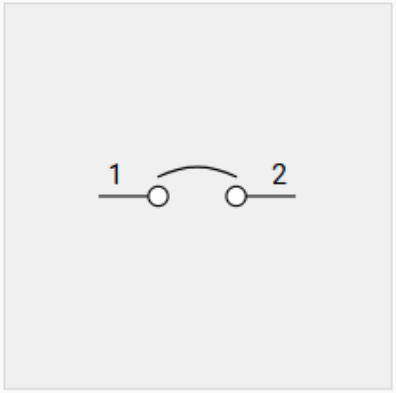


PTC Fuses & Resettable Fuses

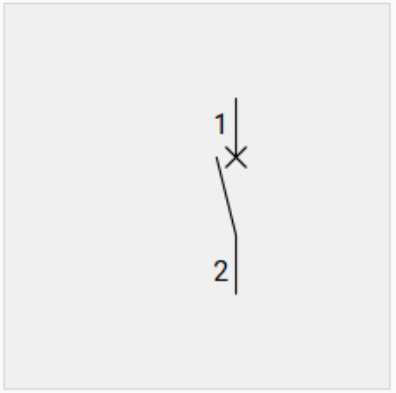
Circuit Breakers

- Switching and protecting various parts of the power system
- Can operate in manual mode or automatic mode
- Can make or break the circuit under no-load, full load or fault conditions.

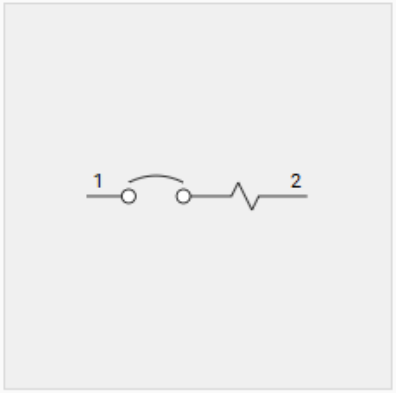
Circuit Breakers



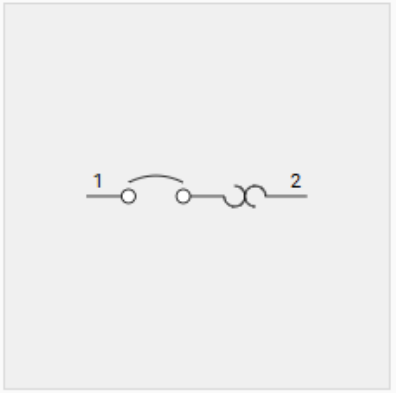
Circuit Breaker 1P



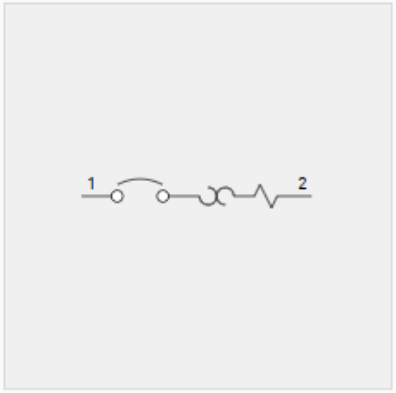
Circuit Breaker 1P



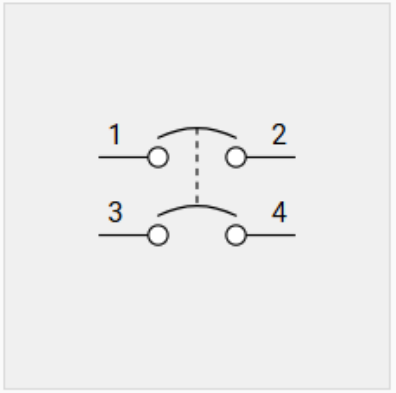
Circuit Breaker 1P - Magnetic



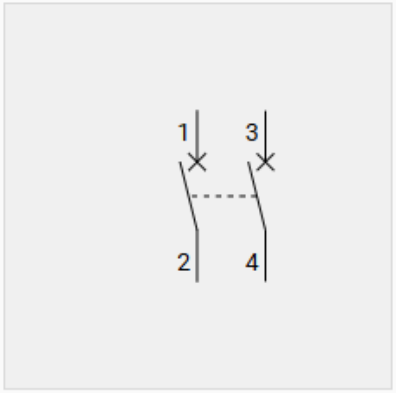
Circuit Breaker 1P - Thermal



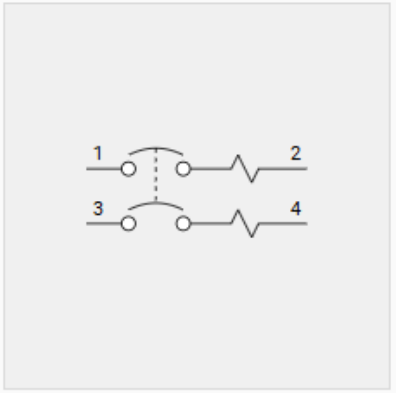
Circuit Breaker 1P - Thermal/Magnetic



Circuit Breaker 2P



Circuit Breaker 2P



Circuit Breaker 2P - Magnetic

Circuit Breakers

- Low voltage circuit breakers are rated below 1000 V
- High voltage circuit breakers are rated at above 1000 V.

- Types of high voltage circuit breakers:
- Oil circuit breakers
- Air blast circuit breakers
- Vacuum circuit breakers
- SF6 circuit breakers

Voltage Rating of Circuit Breakers

- Low voltage CB (Below 1KV)
  - MCB, MCCB, ACB
  - single phase circuit breaker (230 V)
  - three phase circuit breaker (400V)

- Medium Voltage Circuit Breakers(1KV-66KV)
  - 3.3KV, 6.6KV, 11KV, 22KV
  - SF6 or Vacuum Circuit Breakers

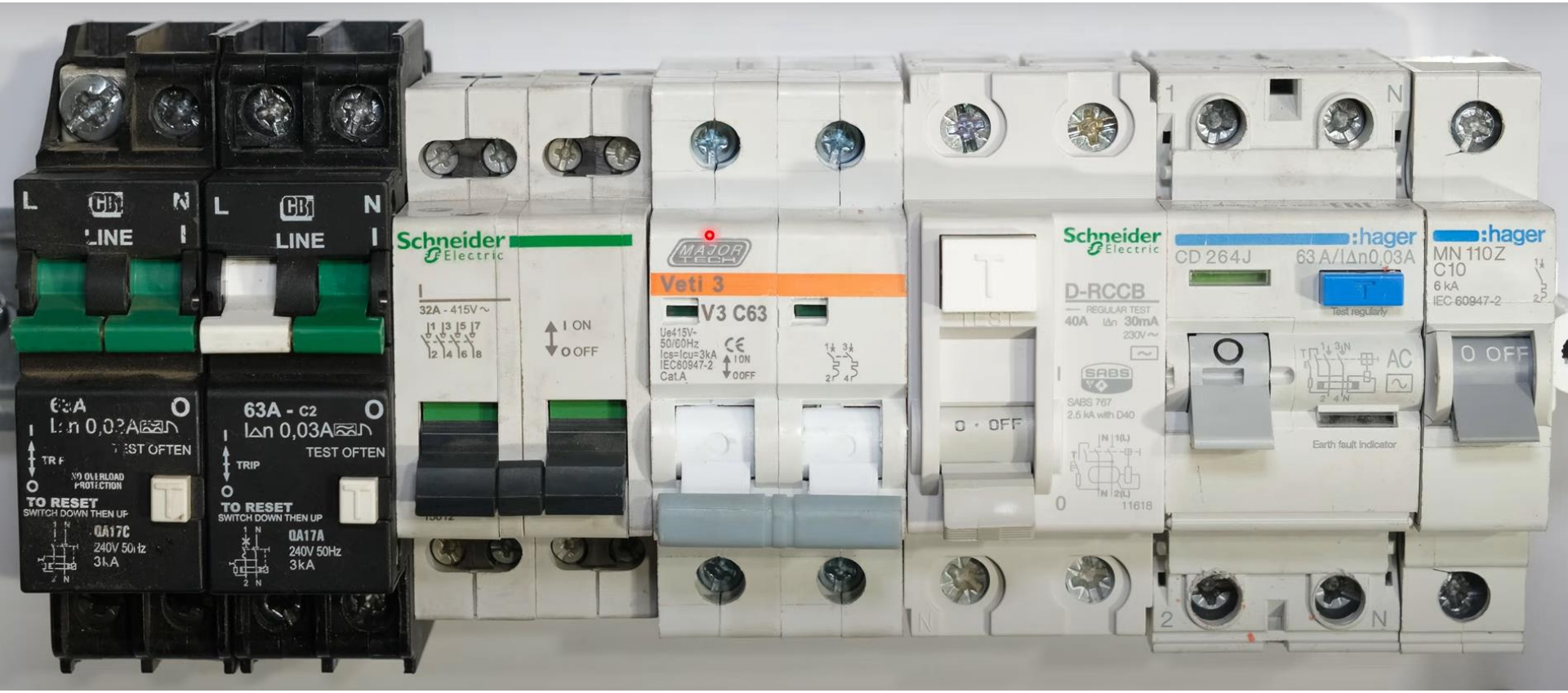
- High Voltage Circuit Breakers (66KV-500KV)
  - 132KV, 220KV, 500KV
  - Oil or SF6

- Single Phase or Three Phase circuit Breakers
  - Apparent Power < 5KVA, use single phase breakers
  - Apparent Power > 5KVA , use three phase breakers

Low Voltage Circuit Breakers

- Low voltage circuit breakers are rated below 1000 V
- MCB - Miniature Circuit Breakers
- MCCB - Molded Case Circuit Breakers
- ACB – Air Circuit Breakers

Miniature Circuit Breakers



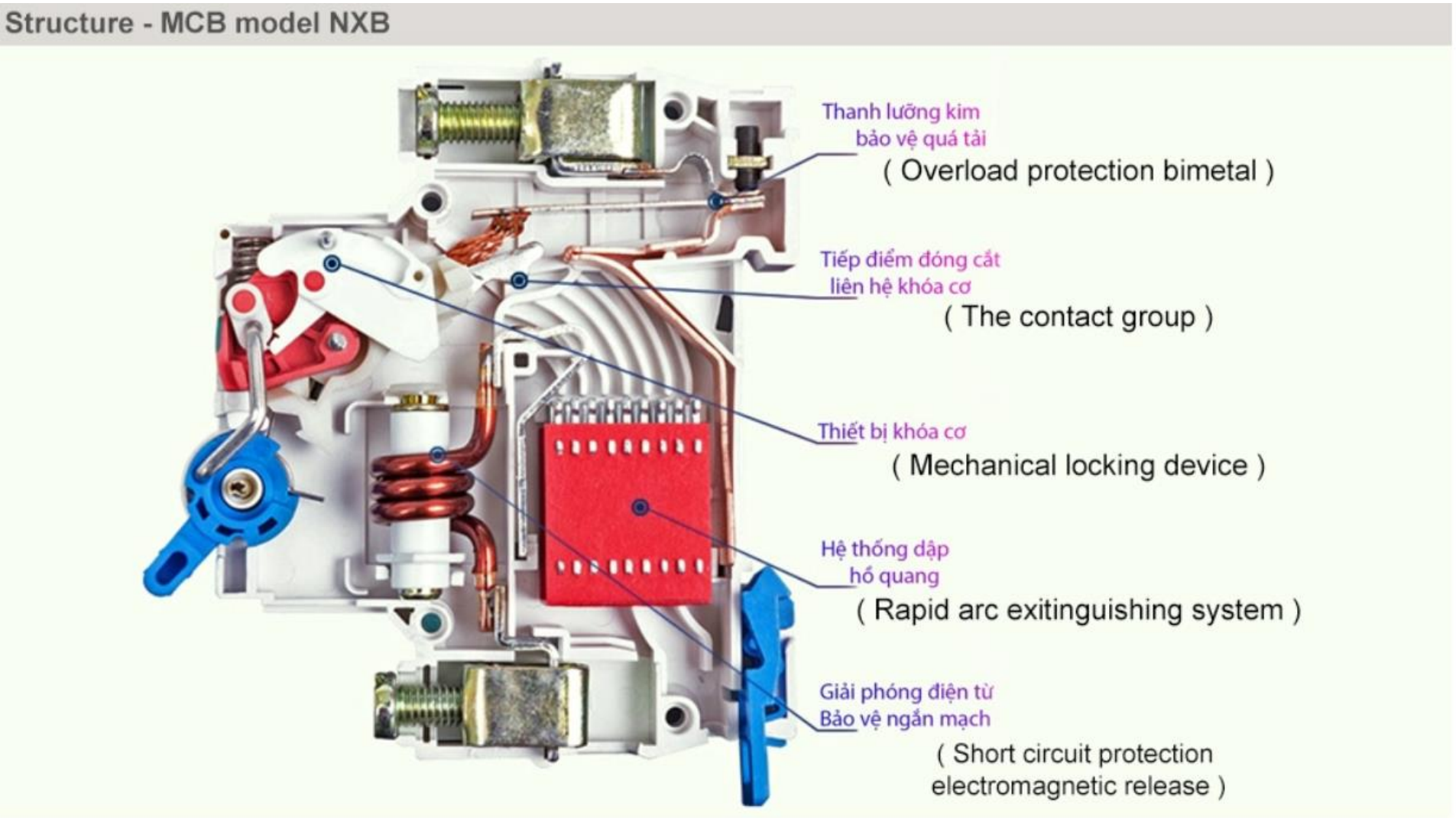
MCB

- OCPD rated up to 125A and 1000V
- Automatically operated electrical switch.
- Designed to protect an electrical circuit from overloads or short circuits.
- Commonly used in residential, commercial, and industrial applications.

Working Principle of MCB

- Thermal Trip (for **overload**): Uses a bimetallic strip that bends when heated.
- Magnetic Trip (for **short circuit**): Electromagnetic coil reacts to short circuits.

Structure of MCB



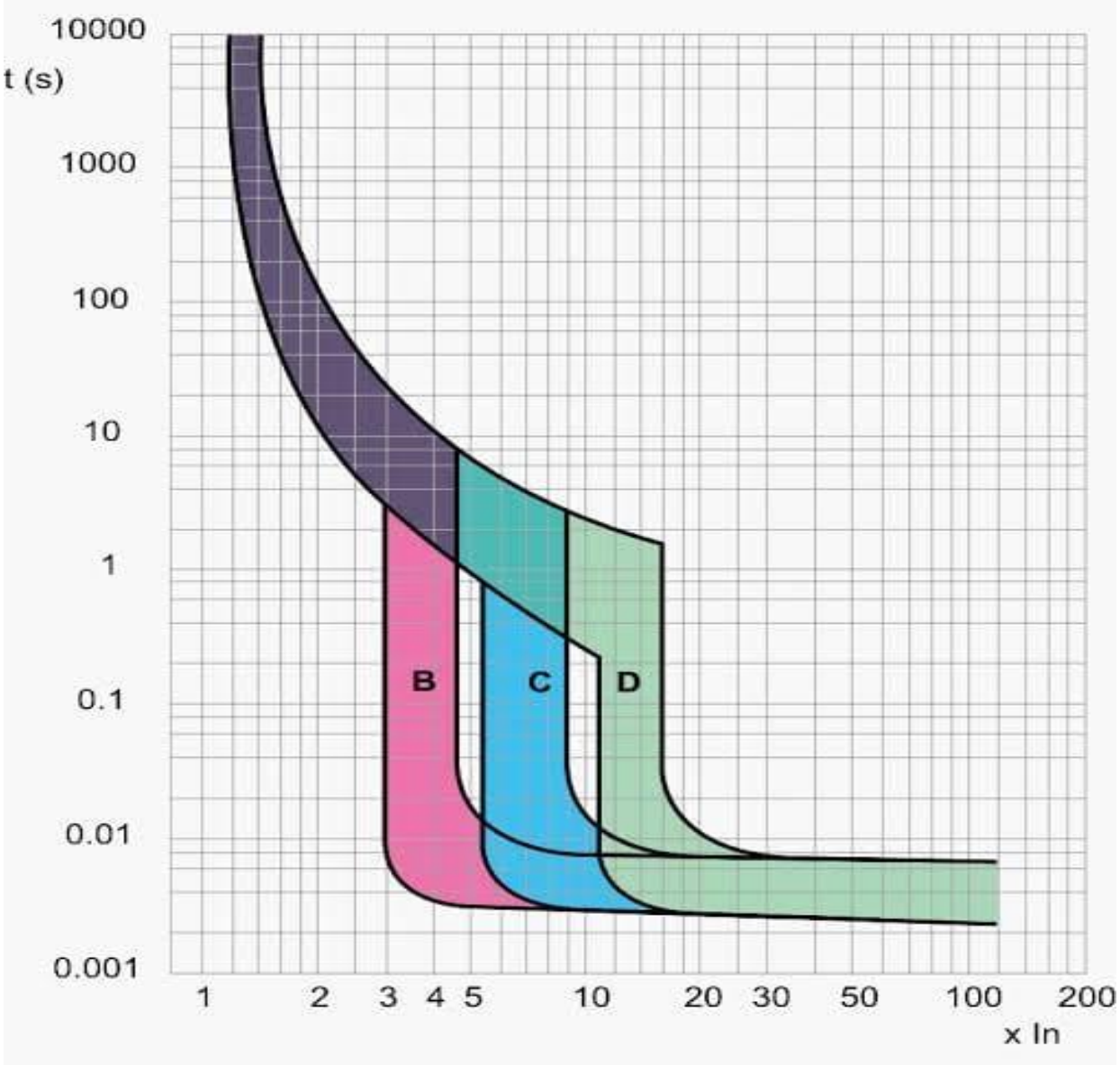
Characteristics of MCB

- Rated voltage: Ue
- Rated current: In
- Tripping current for overload protection (Ir) and for short-circuit protection (Im)
- Short-circuit current breaking rating (Icn)

Current Characteristics of MCB

- In: Maximum current that an MCB can carry indefinitely without tripping.
- Im: Fault current at which MCB trips the circuit-breaker rapidly.
- Icu: The short-circuit current-breaking rating of a CB is the highest value of current that the CB is capable of breaking without being damaged.

Trip curves of MCB



Common Types of MCB

- B: Trips at 3-5 times rated current (used in homes).
- C: Trips at 5-10 times rated current (used in commercial settings).
- D: Trips at 10-20 times rated current (for heavy-duty machinery)..

Common Types of MCB

Type	Tripping Current	Operating Time	Use
Type B	3 – 5 times of FLC	0.04 to 13 Sec	Resistive, Domestic Applications
Type C	5 – 10 times of FLC	0.04 to 5 Sec	Commercial And Industrial use
Type D	10 – 20 times of FLC	0.04 to 3 Sec	High Starting Current - Motor
Type K	8 - 12 times of FLC	Less than 0.1 Sec	Battery Charger X Ray Machines Welding X-mer

Current rating of MCB

Time / current characteristics for Type B circuit-breakers to BS EN 60898 and RCBOs to BS EN 61009	
Current for time 0.1 sec to 5 secs	
Rating	Current
6 A	30 A
10 A	50 A
16 A	80 A
20 A	100 A
25 A	125 A
32 A	160 A
40 A	200 A
50 A	250 A
63 A	315 A
80 A	400 A
100 A	500 A
125 A	625 A

Time / current characteristics for Type C circuit-breakers to BS EN 60898 and RCBOs to BS EN 61009	
Current for time 0.1 sec to 5 secs	
Rating	Current
6 A	60 A
10 A	100 A
16 A	160 A
20 A	200 A
25 A	250 A
32 A	320 A
40 A	400 A
50 A	500 A
63 A	630 A
80 A	800 A
100 A	1000 A
125 A	1250 A

Time / current characteristics for Type D circuit-breakers to BS EN 60898 and RCBOs to BS EN 61009	
Current for time 0.1 sec to 5 secs	
Rating	Current
6 A	120 A
10 A	200 A
16 A	320 A
20 A	400 A
25 A	500 A
32 A	640 A
40 A	800 A
50 A	1000 A
63 A	1260 A
80 A	1600 A
100 A	2000 A
125 A	2500 A

MCB Sizing Procedure (Resistive Loads)

- Determine the Load Current
- Apply a Safety Factor of 1.25
- Choose standard breaker size
- Check Conductor Size
- Choose the Correct Tripping Curve

MCB Sizing Procedure (Motor Loads)

- Determine the Full Load Current
- Apply a Safety Factor of 1.5 or 2.5
- Choose standard breaker size
- Choose the Correct Tripping Curve
- Choose Conductor Size 1.25 times FLC
- Choose OLR 1.15 times FLC

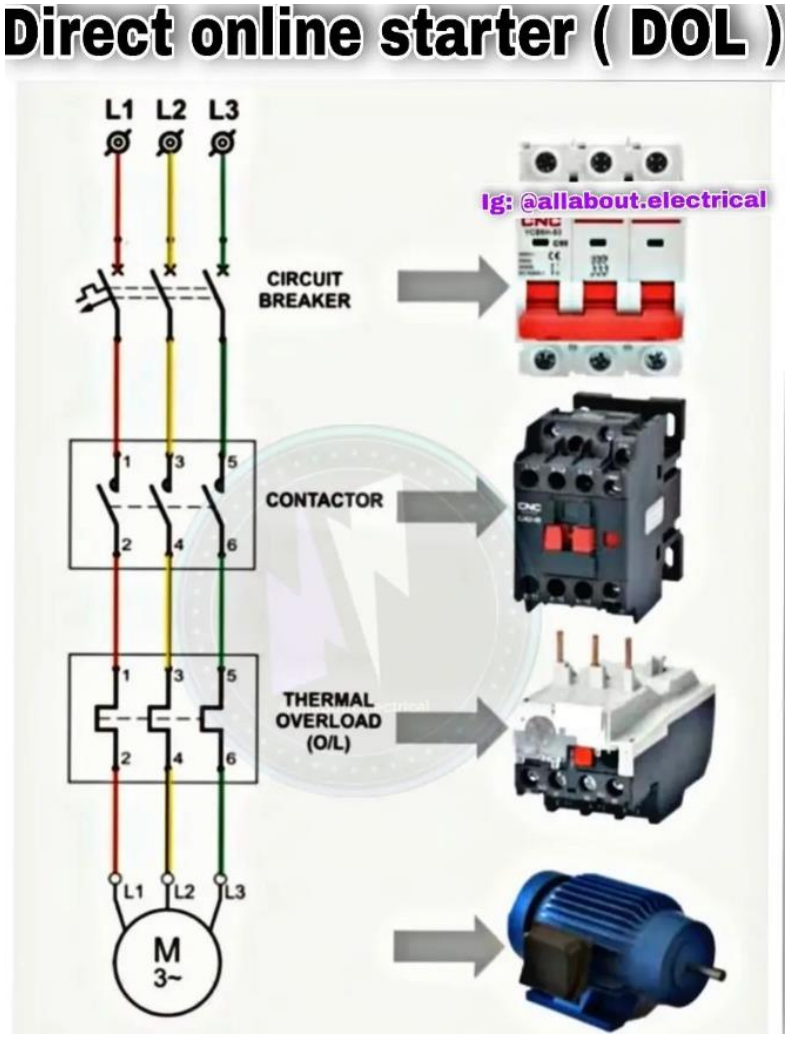
MCB Sizing Procedure

Cable Size And Load Amp,Breaker Size

Cable Size	Maximum Ampere	Breaker Size
1.5 mm	14 A	10 A
2.5 mm	22 A	20 A
4 mm	33 A	32 A
6 mm	42 A	32 A
10 mm	58 A	50 A
16 mm	77 A	63 A
25 mm	102 A	80 A
35 mm	125 A	100 A
50 mm	150 A	125 A
70 mm	192 A	160 A
95 mm	230 A	200 A
120 mm	267 A	250 A
150 mm	290 A	250 A
185 mm	348 A	345 A
240 mm	409 A	400 A

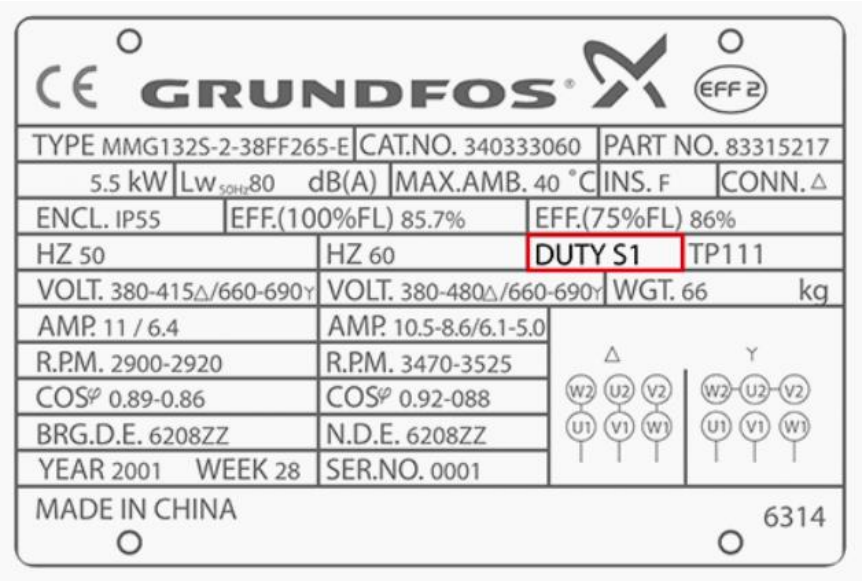
OLR and CONTACTORS

OLR and CONTACTORS

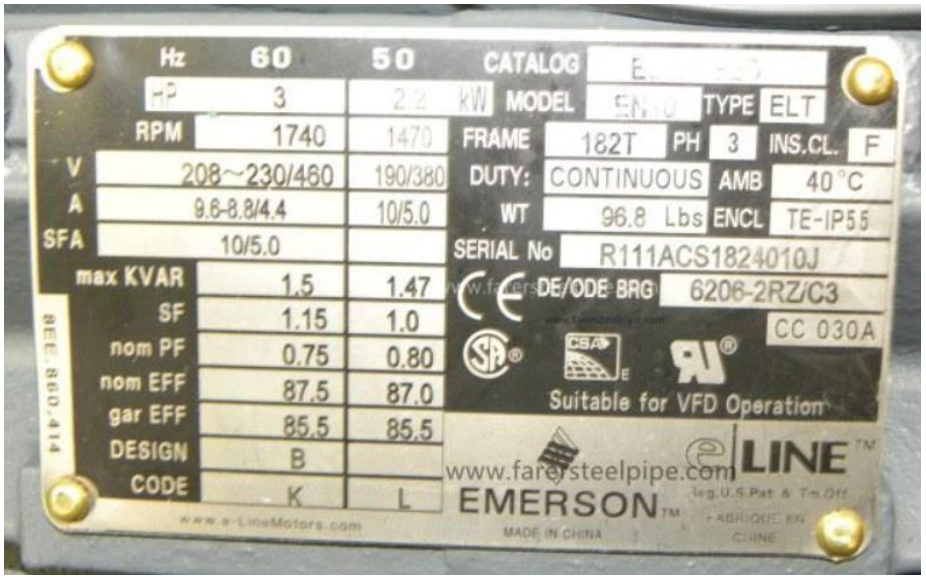


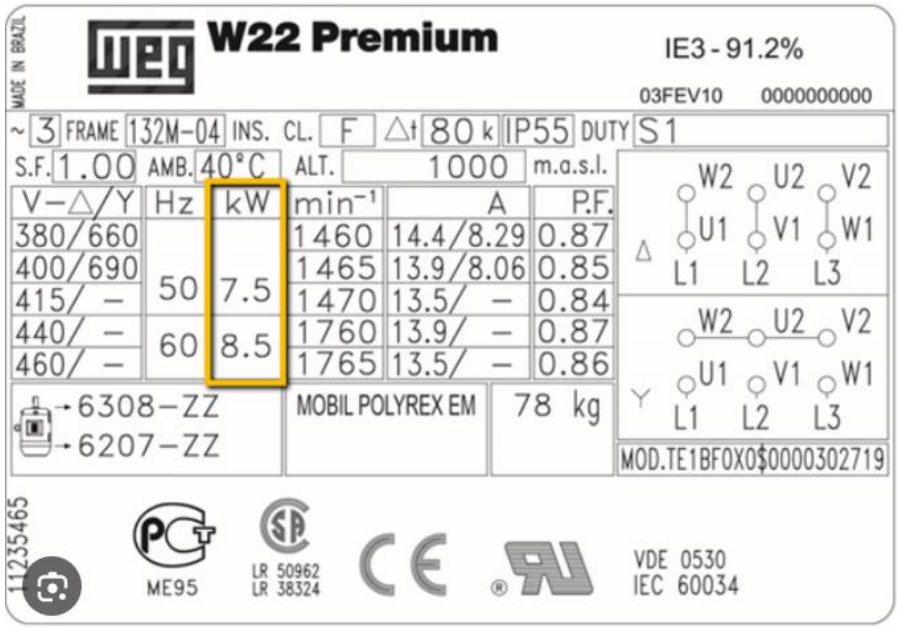
NAMEPLATES


TECHNIK EESTI
MODEL :- TECHNIK S60
GEAR RATIO :- 1/40
STATIC LOAD :- 3000 Kg
OIL :- 3.0 ltr.
A.C. INDUCTION MOTOR FOR DRIVING LIFT
POWER = 3.7 kW / 5.0 HP
400V, 50 Hz, 3 Ø
SPEED = 1.0 mps
TYPE = VVVF
Ir = 9 A
RPM = 1440
DUTY = S4
EFFICIENCY(%) = 85.0
COSØ = 0.84
ST/H = 200
CONN. = λ
SR. NO.
MONTH & YEAR
JAN 2022
INSU.CLASS = F
IP = 20


GRUNDFOS
EFF 2
TYPE MMG132S-2-38FF265-E
CAT.NO. 340333060
PART NO. 83315217
5.5 kW
Lw 80 dB(A)
MAX.AMB. 40 °C
INS. F
CONN. Δ
ENCL. IP55
EFF.(100%FL) 85.7%
EFF.(75%FL) 86%
HZ 50
HZ 60
DUTY S1
TP111
VOLT. 380-415Δ/660-690Y
VOLT. 380-480Δ/660-690Y
WGT. 66 kg
AMP. 11 / 6.4
AMP. 10.5-8.6/6.1-5.0
R.P.M. 2900-2920
R.P.M. 3470-3525
COSφ 0.89-0.86
COSφ 0.92-088
BRG.D.E. 6208ZZ
N.D.E. 6208ZZ
YEAR 2001 WEEK 28
SER.NO. 0001
Δ
Y
W2 U2 V2
U1 V1 W1
MADE IN CHINA
6314

NAMEPLATES


Hz 60 50
HP 3
RPM 1740
V 208~230/460
A 9.6-8.8/4.4
SFA 10/5.0
max KVAR 1.5
SF 1.15
nom PF 0.75
nom EFF 87.5
gar EFF 85.5
DESIGN B
CODE K
CATALOG
MODEL
TYPE ELT
FRAME 182T
PH 3
INS.CL. F
DUTY: CONTINUOUS
AMB 40°C
WT 96.8 Lbs
ENCL TE-IP55
SERIAL No R111ACS1824010J
DE/ODE BRG 6206-2RZ/C3
CC 030A
Suitable for VFD Operation
www.farersteelpipe.com
e-LINE
EMERSON
MADE IN CHINA


MADE IN BRAZIL
WEG W22 Premium
IE3 - 91.2%
03FEV10 0000000000
3 FRAME 132M-04 INS. CL. F Δt 80 k IP55 DUTY S1
S.F. 1.00 AMB. 40°C ALT. 1000 m.a.s.l.
V-Δ/Y Hz kW min⁻¹ A P.F.
380/660 50 7.5 1460 14.4/8.29 0.87
400/690 50 7.5 1465 13.9/8.06 0.85
415/ - 50 7.5 1470 13.5/ - 0.84
440/ - 60 8.5 1760 13.9/ - 0.87
460/ - 60 8.5 1765 13.5/ - 0.86
6308-ZZ
6207-ZZ
MOBIL POLYREX EM
78 kg
W2 U2 V2
U1 V1 W1
L1 L2 L3
MOD.TE1BF0X0$0000302719
11235465
ME95
LR 50962
LR 38324
VDE 0530
IEC 60034

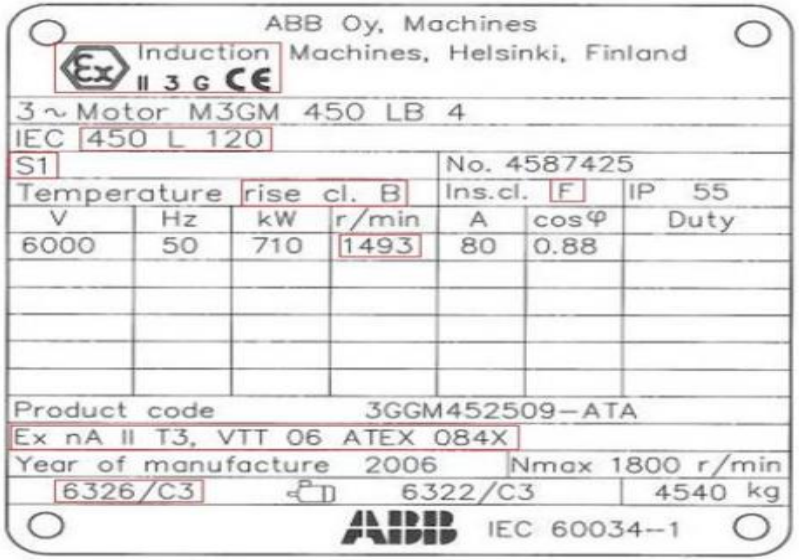
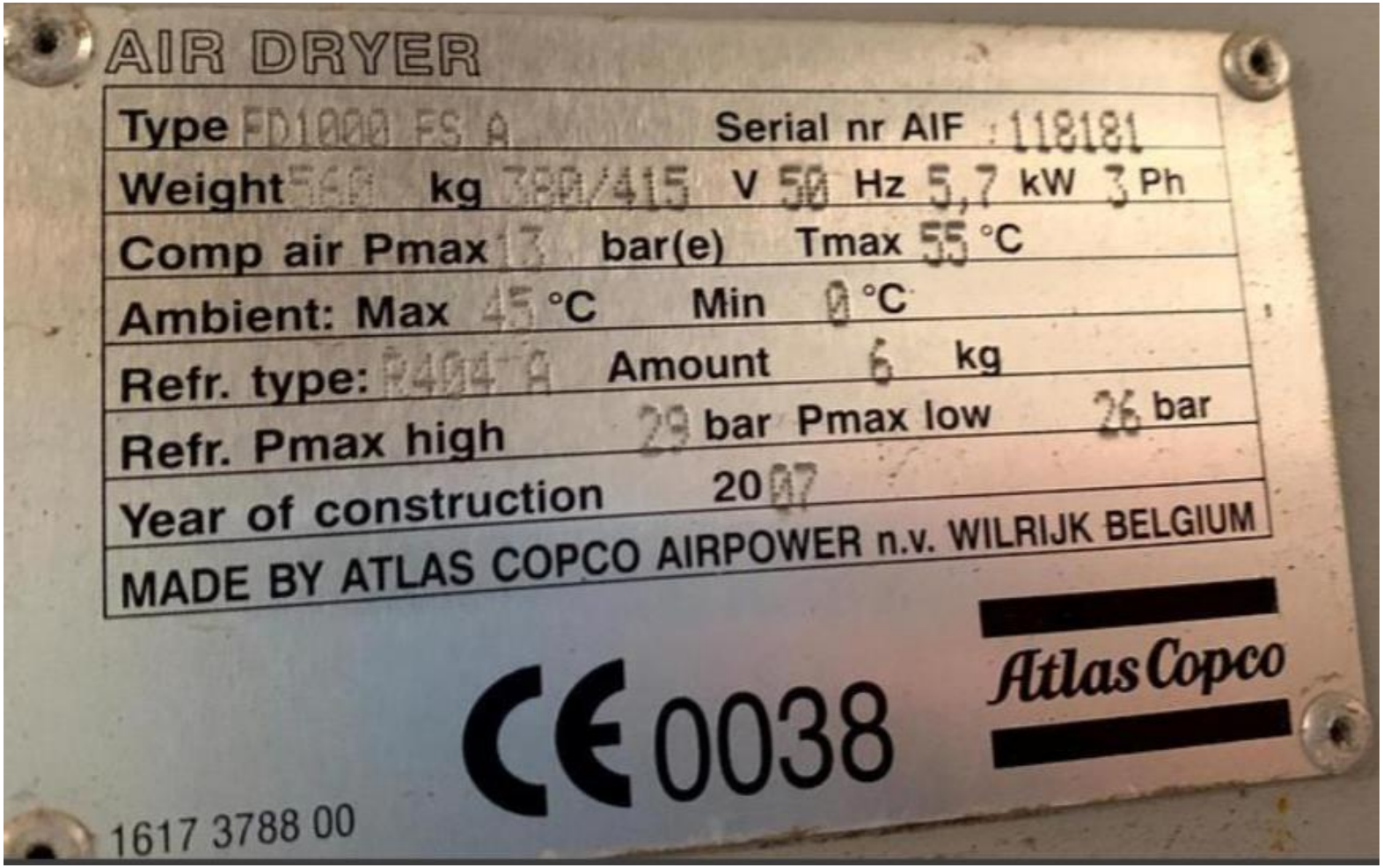


ABB Oy, Machines
Induction Machines, Helsinki, Finland
II 3 G CE
3~ Motor M3GM 450 LB 4
IEC 450 L 120
S1
No. 4587425
Temperature rise cl. B
Ins.cl. F
IP 55
V Hz kW r/min A cosφ Duty
6000 50 710 1493 80 0.88
Product code 3GGM452509-ATA
Ex nA II T3, VTT 06 ATEX 084X
Year of manufacture 2006
Nmax 1800 r/min
6326/C3
6322/C3
4540 kg
ABB
IEC 60034-1


Electric Oven
Model : SEBO-911E Temperature : 30°C~300°C
Waterproofing Grade : IPX4 Power : 3.2kW
Frequency : 50~60HZ Volts : 220V
Serial Number: 112019050012 Date: 2019.05
Dimension: 950X600X430 (mm)

NAMEPLATES


AIR DRYER
Type FD1000 FS A
Serial nr AIF : 118181
Weight 540 kg 380/415 V 50 Hz 5,7 kW 3 Ph
Comp air Pmax 13 bar(e) Tmax 55 °C
Ambient: Max 45 °C Min 0 °C
Refr. type: R404 A Amount 6 kg
Refr. Pmax high 29 bar Pmax low 26 bar
Year of construction 2007
MADE BY ATLAS COPCO AIRPOWER n.v. WILRIJK BELGIUM
CE 0038
Atlas Copco
1617 3788 00

MCB vs MCCB

MCB	MCCB
It stands for Miniature Circuit Breaker.	It stands for Molded Case Circuit Breaker.
Rated current not more than 125 Ampere.	Rated Current up to 1600A
Its interrupting current rating is under 10KA	Their interrupting current ranges from around 10KA -85KA
Judging from their power capacities, MCB is mainly used for low Breaking capacity requirement mainly domestic.	MCCB is mainly used for both low and high Breaking capacity requirements mainly industrial.
Its trip characteristics are normally not adjustable since they basically cater to low circuits.	Its trip current may be fixed as well as adjustable for overload and magnetic setting.

MCB and MCCB

Common MCCB Ratings: 160A, 200A, 250A, 400A

MPCB and MCCB

Arcing in CB

- When the current is interrupted under fault conditions, the current density at the tips increase.
- This causes heating and the medium near the contacts ionize.
- Ionization causes flow of current between the contacts and forms an arc.
- The current depends on arc resistance.
- Ionization.
- Length of the arc

Arcing in CB

- Resistance of the arc is increased by
  - Increasing length of the arc
  - Cooling the arc
  - Splitting the arc

- Current zero method of arc extinction
  - Only applies to AC circuits.
  - Depends on the voltage between the voltage and dielectric strength between the contacts.

Operation of CBs under faults

- Breaking the circuit under fault conditions
- Making the circuit under fault conditions
- Carrying the fault current for a short period of time

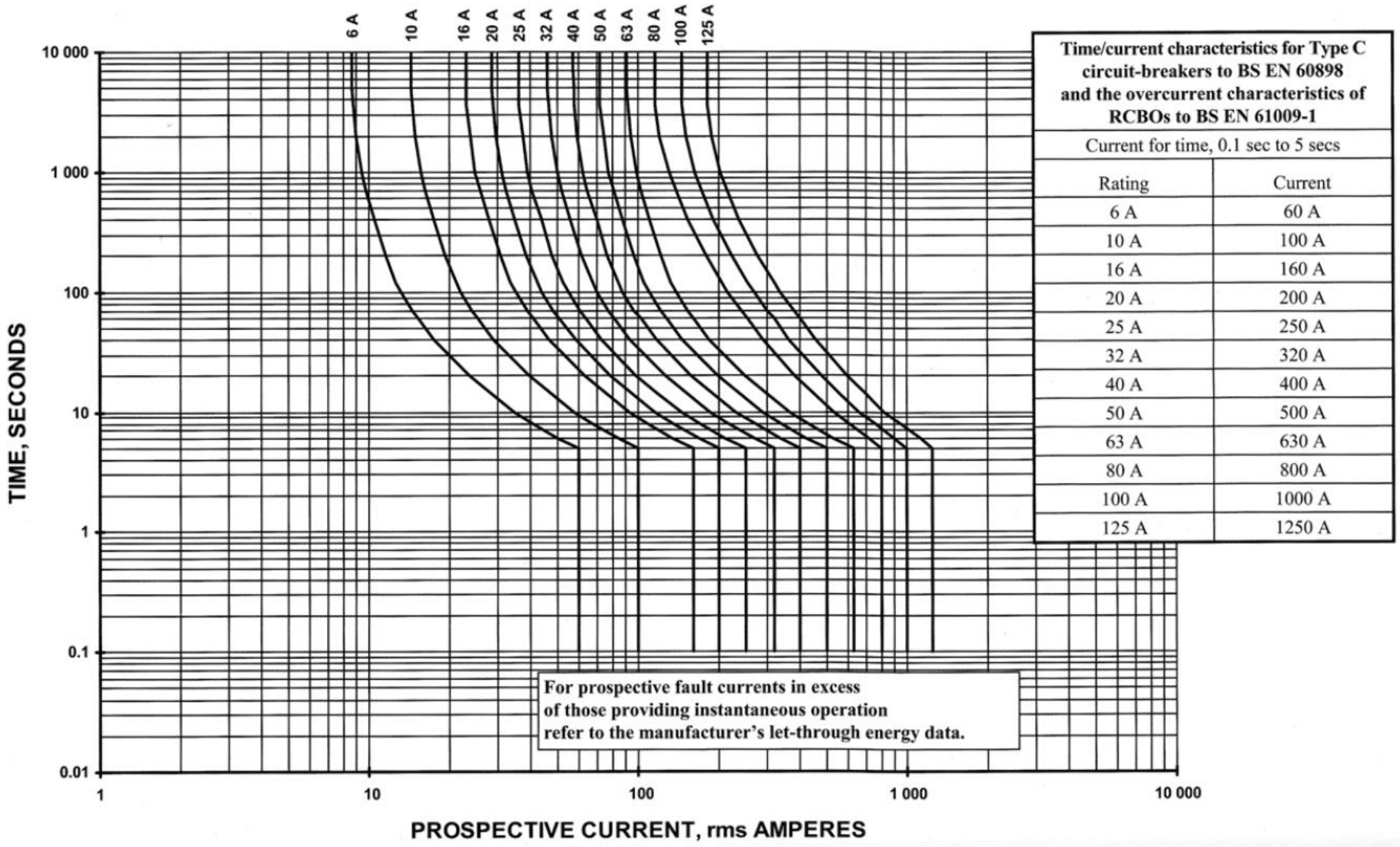
Rating of CB

- Rated Voltage: The maximum voltage for which the circuit breaker is designed.
- Rated Current: The RMS current that the CB can carry continuously.
- Breaking Capacity: Highest short circuit current that the breaker can interrupt.
- Short Time Capacity: The maximum current a circuit breaker can withstand for a short duration (typically 1–3 seconds) without damage.

MCB Trip Curves

- MCB are resettable protective devices against abnormal conditions such as over current/load, short circuits and ground faults.
- Trip curves represent thermal and electromagnetic tripping of circuit breakers.

Fig 3.5 Type C circuit-breakers to BS EN 60898 and RCBOs to BS EN 61009-1



Time/current characteristics for Type C circuit-breakers to BS EN 60898 and the overcurrent characteristics of RCBOs to BS EN 61009-1	
Current for time, 0.1 sec to 5 secs	
Rating	Current
6 A	60 A
10 A	100 A
16 A	160 A
20 A	200 A
25 A	250 A
32 A	320 A
40 A	400 A
50 A	500 A
63 A	630 A
80 A	800 A
100 A	1000 A
125 A	1250 A

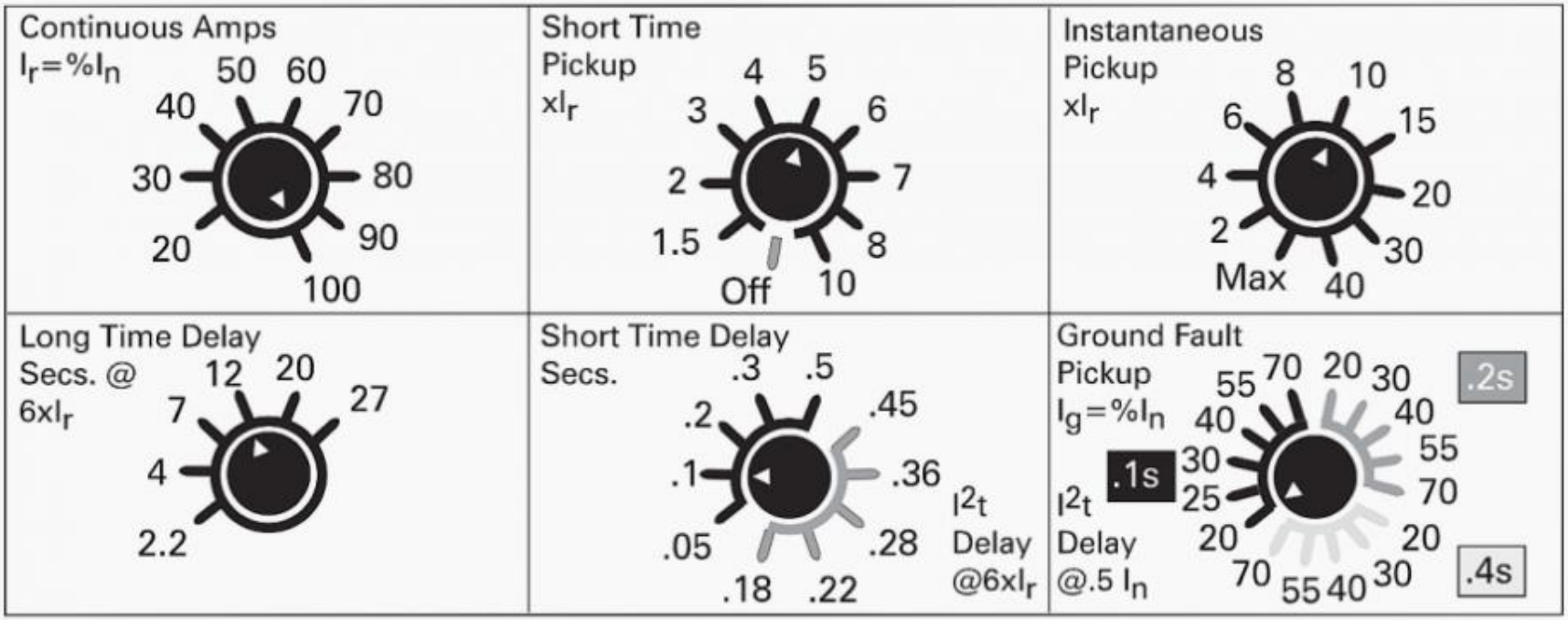
MCB Types

	Type	Tripping Current	Operating Time
1-	**Type B**	*3 To 5 times the full load current*	0.04 To 13 Sec
2-	**Type C**	*5 To 10 times the full load current*	0.04 To 5 Sec
3-	**Type D**	*10 To 20 times the full load current*	0.04 To 3 Sec
4-	**Type K**	*8 To 12 times the full load current*	<0.1 Sec
5-	**Type Z**	*2 To 3 times the full load current*	<0.1 Sec

Uses of MCB

MCB type	Load Type	Example	Appliances
B Type	Small, Resistive circuits	Control circuits, domestic appliances	Control circuits, domestic lights, TV
C Type	Small inductive and big resistive loads	Small motors Industrial lighting big domestic appliances	Oven, heaters, washing machine, fans, factory lights
D Type	Big inductive loads	Industrial medium and big motors.	5kw motors and above

CB Adjustments



Circuit breaker adjustable tripping functions

Earth Leakage Current

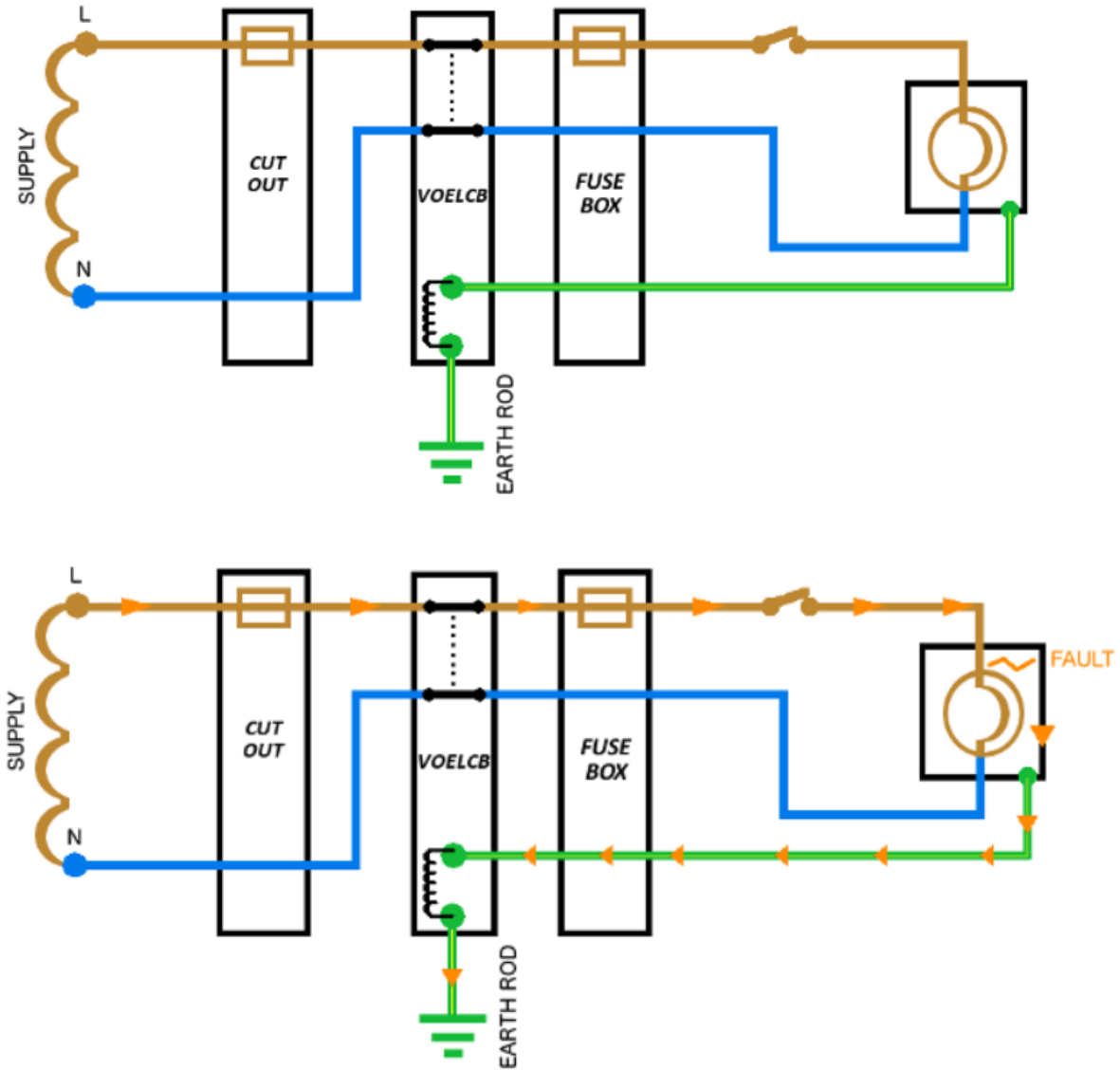
- Earth Leakage Current is the unintentional flow of electrical current from a live conductor to the earth (ground) in an electrical system.

- Safety devices should detect leakage currents (5–30 mA) and disconnect the circuit less than 30 milliseconds to prevent device damage or electrocution.

Voltage Operated ELCB

- Safety devices used in electrical installations to prevent shock and fire from leakage currents.
- Detects voltage rise between the metalwork of the installation and the earthed electrode.
- When the voltage rises to a threshold level a voltage sensitive coil energizes and disconnects the incoming supply.

VO-ELCB


L
SUPPLY
N
CUT
OUT
VOELCB
FUSE
BOX
EARTH ROD
L
SUPPLY
N
CUT
OUT
VOELCB
FUSE
BOX
FAULT
EARTH ROD

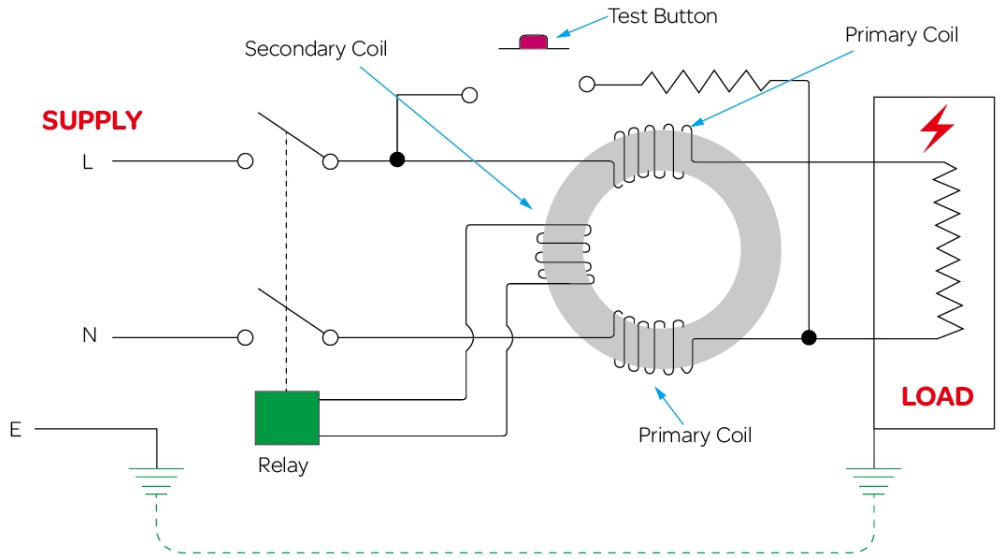
Disadvantages of VO-ELCB

- Requires a solid connection to an earth electrode.
- Slow operation and less sensitive
- Possibility of short circuiting the voltage coil and disabling the device

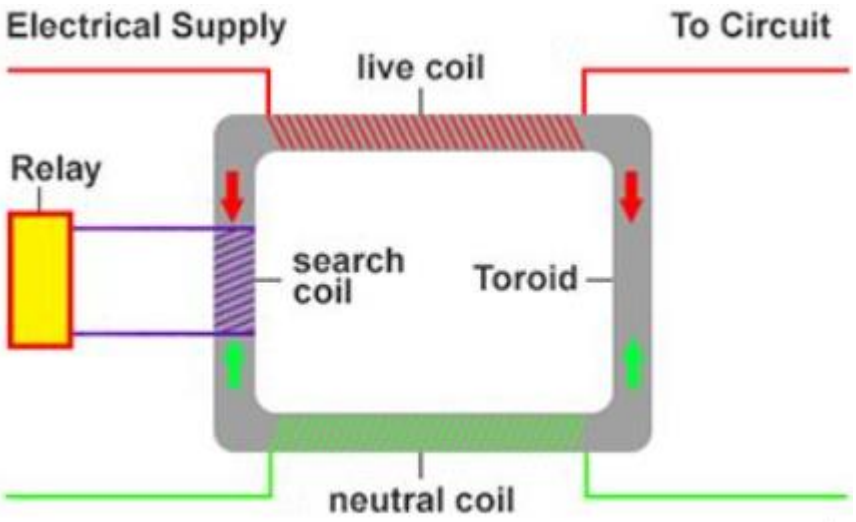
Residual Current Circuit Breaker

- RCCB or RCD is an electrical safety device, that interrupts an electrical circuit when the current passing through line and neutral conductors of a circuit is not equal.
- If the residual current exceeds 30mA, the RCD will trip.
- RCDs operate by measuring the current difference between line and neutral conductor using a differential current transformer.
- Resettable and should be tested regularly.
- Common Ratings: 25A, 32A, 40A, 63A
- 2P/4P, 30mA, 100mA, 300mA

Schematic Diagram of RCD



Working Priinciple of Residual Current Circuit Break



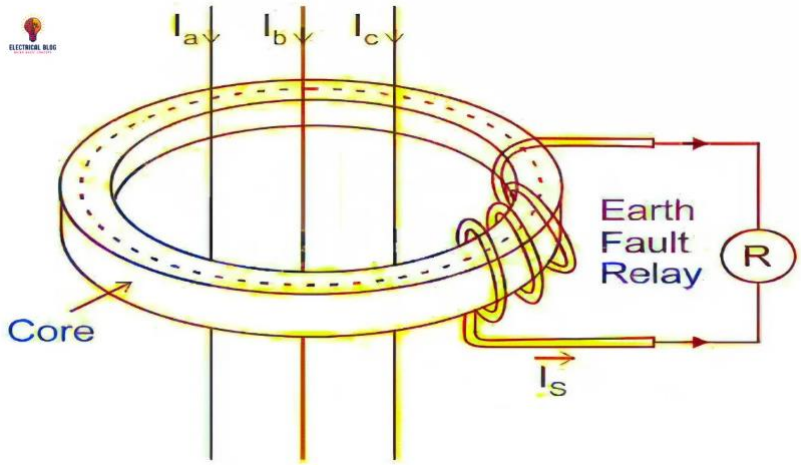
Components of RCD/RCCB

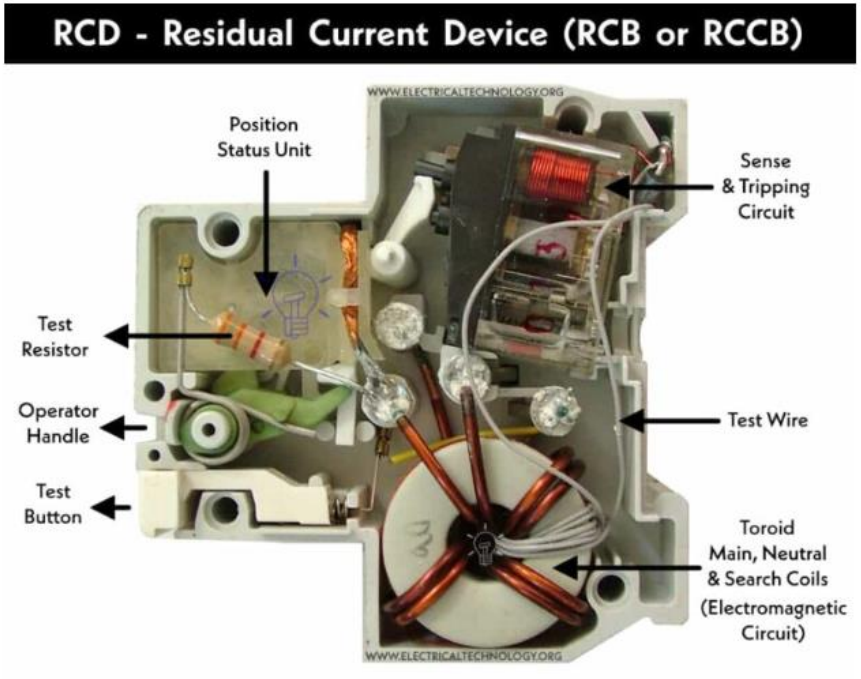
- Core Balance Current Transformer/ Toroidal Coil – Senses current imbalance.
- Trip Mechanism – Electromechanical relay
- Test Circuit – Simulates a fault for manual testing.
- Contacts – Opens the circuit during a fault.

Core Balance Current Transformer or ZCT

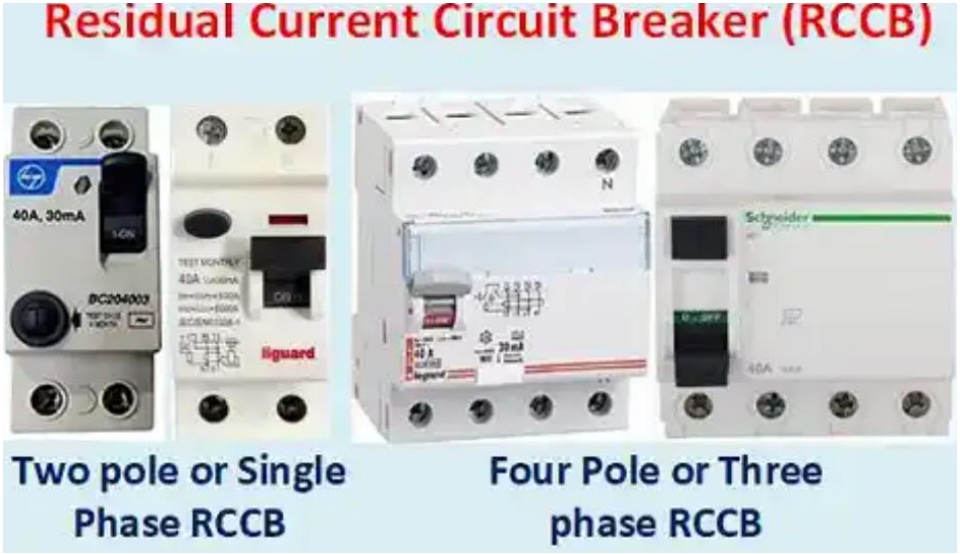
- Normally the currents in each phase are balanced, and their vector sum is equal to zero.
- Under balanced conditions, the magnetic fluxes generated cancel out within the ZCT's core, and no induced current flows in the secondary winding.
- When there is an earth fault, the balance is lost and the resulting residual current produces a magnetic field which induces a current in the secondary coil.

ZCT


I_a
I_b
I_c
Earth
Fault
Relay
R
Core
I_s


RCD - Residual Current Device (RCB or RCCB)
WWW.ELECTRICALTECHNOLOGY.ORG
Position
Status Unit
Sense
& Tripping
Circuit
Test
Resistor
Operator
Handle
Test
Button
Test Wire
Toroid
Main, Neutral
& Search Coils
(Electromagnetic
Circuit)
WWW.ELECTRICALTECHNOLOGY.ORG

RCD


Residual Current Circuit Breaker (RCCB)
40A, 30mA
liguard
Two pole or Single Phase RCCB
Four Pole or Three phase RCCB


MIDA-80B
40A
400/415V~
50/60Hz
Type B
Test Monthly
OFF
IEC/EN61008-1
IEC/EN62423


MIDA-80B
40A
230/240V~
50/60Hz
Type B
Test Monthly
OFF
IEC/EN61008-1
IEC/EN62423


MAX GUARD
press button to trip test monthly
63A ML63-1
I∆n 0.1A
IEC 61008-1
240V~ 50/60Hz AC
Inc = I∆c = 10kA
MAXGUARD
MAX GUARD
press button to trip test monthly
40A ML63-1
I∆n 0.1A
IEC 61008-1
240V~ 50/60Hz AC
Inc = I∆c = 10kA
MAXGUARD


Type B
Push Monthly
EKL1 - 63
In 63A
I∆n 0.03A
Un 400/415V ~
50/60Hz
Im= I∆m = 500A
Inc= I∆c = 6000A
IEC/EN 61008-1
IEC/EN 62423